The Gameplay Enjoyment Model

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ABSTRACT

To date, reviews of the games literature have noted a lack of empirical studies examining the relationships between games and their purported benefits (Huizenga, Admiraal, & Dam, 2011; Vandercruysse, Vanderwaetere, & Clarebout, 2012; Young et al., 2012). Furthermore, researchers have called for a better understanding of the specific game features that may lead to beneficial outcomes (Hartmann & Klimmt, 2006; Klimmt, Schmid, & Orthmann, 2009; McNamara, Jackson, & Graesser, 2010; Vorderer, Bryant, Pieper, & Weber, 2006; Wilson et al., 2009). In this survey study, a structural equation modeling (SEM) approach was employed to better understand the specific features that influence player enjoyment of video games. The resulting Gameplay Enjoyment Model (GEM) explains players' overall Enjoyment of games, as well as their preferences for six specific types of enjoyment, including Challenge, Companionship, Competition, Exploration, Fantasy, and Fidelity. The implications of these model components are discussed in the context of educational game design and future directions for research are offered. GEM provides an empirical framework within which vital progress can be made in understanding the enjoyment of games and the role that games play in education.

Keywords: Education, Enjoyment, Game Design, Individual Differences, Serious Games, Video Games

INTRODUCTION

While video games have become a major talking point in education (Barab, Gresalfi, & Ingram-Goble, 2010; Gee, 2003, 2007; Prensky, 2001, 2007), healthcare (Bergeron, 2006; Thompson et al., 2010; Wood, 2008), and social change (Barab, Dodge, Gentry, Saleh, & Pettyjohn, 2011; Bogost, 2007; McGonigal, 2011), amongst other disciplines, recent literature reviews have noted a lack of quality empirical studies examining the relationships between games and their purported benefits (Huizenga et al., 2011; Vandercruysse, et al., 2012; Young, et al., 2012). Furthermore, several researchers have called for a better understanding of the specific game features that may lead to beneficial outcomes. Hartmann & Klimmt (2006) stressed the need to investigate personal attributes and specific, detailed preferences for video games. Simultaneously, Vorderer, Bryant, Pieper, & Weber (2006) noted that while certain foundational elements of importance to games have been identified, such as challenge and competition, they have not been clearly defined. Later, Wilson et al. (2009) pointed to a lack of knowledge about which game characteristics affect learning outcomes. Similarly,

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McNamara, Jackson, Graesser, & Baek (2010) called for research on which game features are most important to the motivational and learning benefits of games. Most recently, Vandercruysse et al. (2012) and Young et al. (2012) cited a lack of specificity, abundant overgeneralization, and insufficient consideration of individual differences as hampering empirical progress towards understanding the learning effects associated with educational games. From these recommendations, there is a clear need to identify the specific game features that influence player perception and hold potential benefits for educational gaming.

A few prior studies have shown positive relationships between educational games and learning performance. In a series of three studies, undergraduate business, economics, and management students who played educational games as a part of their respective courses showed statistically significantly higher test scores than students who did not play the games (Blunt, 2007). Likewise, pre-post academic performance increases have been demonstrated in K-12 social studies using an off-the-shelf commercial game (Foster, 2011) and in undergraduate history education using a modified commercial game (Moshirnia & Israel, 2010). Similarly, the use of games has lead to pre-post learning gains in K-12 math education (Cordova & Lepper, 1996; Ke & Grabowski, 2007; Parker & Lepper, 1992). So too have learning performance improvements been demonstrated through the use of science games at the K-12 (Clark et al., 2011) and undergraduate levels (Barab et al., 2009).

Although empirical research investigating the relationships between games, enjoyment, and learning, is limited, promising evidence from related fields suggests that these relationships warrant further exploration. In the field of information systems, enjoyment has shown several positive benefits for the adoption of internet and computer systems. Enjoyment has been associated with increased perceptions of usability (Venkatesh, 2000; Venkatesh, Speier, & Morris, 2002; Yi & Hwang, 2003) and usefulness (Mitchell, Chen, & Macredie, 2005; Venkatesh, et al., 2002; Yi & Hwang, 2003). In addition, users who enjoy systems have shown increased future intention to use those systems (Lee, Cheung, & Chen, 2005; Moon & Kim, 2001), as well as more positive attitudes towards them (Lee, et al., 2005; Moon & Kim, 2001; Van der Heijden, 2003). In some cases, enjoyment has even lead to higher actual use of computers and the internet (Igbaria, Parasuraman, & Baroudi, 1996; Teo, Lim, & Lai, 1999).

Meanwhile, in the field of education, enjoyment has been similarly linked to beneficial outcomes. In studies of university students in online and face to face learning environments, enjoyment was associated with increases in perceived learning and transfer (Blunsdon, Reed, McNeil, & McEachern, 2003; Gomez, Wu, & Passerini, 2010; Mitchell, et al., 2005). In another study, students who enjoyed online learning reported barriers, such as lacking social interaction, instructor issues, and low personal motivation, to be substantially lower than students with neutral or negative attitudes towards online learning (Muilenburg & Berge, 2005). Moreover, in a series of studies on academic emotions, Pekrun, Goetz, Titz, & Perry (2002) found that enjoyment lead to increased perceptions of self-regulated learning and predicted high academic achievement.

Although other experiences may be associated with playing games, enjoyment can be considered the primary experience derived from gameplay. Enjoyment has been characterized as the core experience of all entertainment media, including games (Ritterfeld & Weber, 2006; Vorderer, Klimmt, & Ritterfeld, 2004). In addition, the enjoyment of games has been related to several preceding media theories, including uses and gratifications (John L Sherry, Lucas, Greenberg, & Lachlan, 2006), selective exposure (Bryant & Davies, 2006), and mood management (Vorderer, et al., 2006). Further, Garris, Ahlers, & Driskell (2002, p. 453) explained that "A central characteristic of games is that they are fun and a source of enjoyment."

Since enjoyment is the primary experience derived from gameplay, and enjoyment has shown positive effects in prior learning and

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technology research, it is worthwhile to consider how educational games can be designed to accrue similar benefits. A potentially useful tool for the creators of serious games, particularly in education, is an empirical model of the game features that lead to player enjoyment. While many taxonomies of games and players have been introduced in the past, they have tended to be theoretical in nature and/or wanting for empirical validation (see Quick, Atkinson, & Lin, 2012b for an extended discussion of game taxonomies). Preliminary empirical efforts have begun to identify the game features that influence player enjoyment (Quick & Atkinson, 2011; Quick, et al., 2012b). Exploratory analyses of survey responses from an 18-feature questionnaire have identified Challenge, Companionship, Competition, Exploration, Fantasy, and Fidelity as factors that influence player enjoyment. To date, each of these factors has been defined by two to four specific game features, such as realistic graphics or online play. Although this research has established an initial understanding of gameplay enjoyment, additional work is needed to refine, expand, and validate these findings.

Overview of Present Study

This survey study aims to build upon the research of Quick et al. (2012b) and transition from an exploratory approach to a confirmatory one. The instrument used by Quick et al. 2012b) is adapted and expanded to explore gameplay enjoyment and player preferences in greater detail. The purpose of this study is to establish a refined and expanded empirical model of gameplay enjoyment, the Gameplay Enjoyment Model (GEM). An examination of the literature reveals that GEM holds promising implications for the design and research of educational games. The applications of GEM to the design of educational games are discussed. In addition, the directions for future research on the benefits of educational games that are enabled by GEM are presented.

METHOD

Participants

Participants were undergraduate learners from a general requirement computer literacy course at a large southwestern university in the United States. They received course credit for participating in the study. In total, 326 valid survey responses were collected. This represents a 90% completion rate after duplicate, straight-line, and blank responses were removed. The participants had a median age of 20 years old and 80% were between the ages of 18 and 24. In terms of gender, 59% were female and 41% were male. They came from a range of undergraduate class levels, including 18% freshman, 27% sophomores, 29% juniors, and 25% seniors. Participants represented many areas of study, including those from arts and humanities (26%), business (21%), education and psychology (21%), science and engineering (21%), and other fields (11%). This sample is considered to represent a healthy cross-section of the U.S. undergraduate learners who are likely to experience games in a higher education context. Since genuine educational gaming contexts will be composed of diverse students (for example, both non-gamers and avid gamers), a variety of participants were selected for this study.

Gameplay Enjoyment Instrument

The instrument asked participants to rate how important 28 design features are to their enjoyment of a video game. Of the 28 items, 18 were adapted from the instrument by Quick et al. (2012b), which measures six factors that influence player enjoyment of video games, including Challenge, Companionship, Competition, Exploration, Fantasy, and Fidelity. The remaining 10 items were originated for this study to improve the specificity and robustness of the six factors identified by Quick et al. (2012b). These 10 new items were written specifically to refine and expand the existing

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GEM components. All item responses were reported on a five-point scale, which ranged from Not at all important (1) to A must-have feature (5). Sample statements from the questionnaire include "The game world contains imaginary creatures," "The game requires me to cooperate with other players," and "The game features lifelike animations." The complete instrument can be found in the Appendix. In addition, each participant reported his or her age, gender, class standing, and area of study.

Procedure

The survey instrument was hosted on the surveymonkey.com website. Participants registered for the study and were provided with the survey link via the Sona Systems online human subjects management system. This system was used to inform potential participants of research opportunities and of their personal progress towards the completion of required research credits in a general requirement computer literacy course. Participants were required to complete the entire survey in a single session of approximately 30-60 minutes. All responses were collected during a three month period in early 2011.

RESULTS

A nested models approach to structural equation modeling (SEM) was employed to empirically model gameplay enjoyment through players' preferences for video game design features. In a nested models approach (Anderson & Gerbing, 1988), multiple feasible structural equation models, each composed of a different arrangement of the same measured variables, are compared in order to identify the optimal model to represent the relationships under examination. This analysis was conducted in R (R Development Core Team, 2012) using the lavaan package (Rosseel, 2012a, 2012b).

In this analysis, four models commonly found in the nested models approach were examined: the single trait model, the correlated traits model, the second-order model, and the bifactor model. The single trait model examines whether a single latent factor can accurately predict the measured variables. The correlated traits model asks whether a collection of correlated latent factors predicts the measured variables. The second-order model suggests that one or more overarching latent variables predicts one or more latent subvariables, which in turn predict the measured variables. Lastly, the bifactor model frames a single latent factor and a collection of latent subfactors as competing to predict the measured variables. That is, both a single overarching latent factor and a subset of latent factors simultaneously predict the measured variables.

Within all four models, the same 28 game design features assessed in this study were used as measured variables. For each latent variable, the scale was set by fixing its first item loading to 1. In the correlated traits, second-order, and bifactor models, which require multiple specific latent variables to be defined, Challenge, Companionship, Competition, Exploration, Fantasy, and Fidelity were used. These factors emerged in prior exploratory modeling of gameplay enjoyment (Quick & Atkinson, 2011; Quick et al., 2012b) and were confirmed through preliminary analyses (Quick, Atkinson, & Lin, 2012a). In the second-order and bifactor models, which require a single overarching latent variable to be defined, a factor representing the general enjoyment of video games was used. This factor represents a participant's overall sentiment towards gameplay enjoyment based on his or her responses to all 28 game design features.

A combination of criteria was used to evaluate the tested structural equation models. In considering the acceptability of the each tested model, the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) were examined. Hu and Bentler (1999) recommend a CFI > .95, RMSEA < .06, and SRMR <.08, to reduce Type I and II errors when detecting misspecified models. Meanwhile, for models with the sample size, quantity of measured variables, and structural complexity found in this study, Hair, Black, Babin, and Anderson

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(2010) recommend a CFI > .92, RMSEA ≤ .08, and SRMR ≤ .08. While an acceptable model is expected to meet these recommended criteria, it is important to note that these values should not be employed as strict decision cutoffs (Marsh, 2004). Therefore, these criteria were carefully considered along with each model's theoretical interpretability. The chi-square, degrees of freedom, CFI, RMSEA, and SRMR values for the four models are presented in Table 1.

Subsequently, the four models were compared via their chi-square values, whereby a lower chi-square value generally indicates a better model (Anderson & Gerbing, 1988). Pairwise chi-square difference tests were conducted to determine the statistical significance of the differences between the model chi-square values given their respective degrees of freedom. These comparisons are presented in Table 2.

Through the assessment of fit indices, chi-square comparisons, and theoretical interpretability, the bifactor model was determined to be the optimal representation of gameplay enjoyment. The bifactor model exceeds the goodness of fit criteria suggested by both Hair et al. (2010) and Hu and Bentler (1999), with $= X^2_{(332)} = 557.823$, CFI = .956, RMSEA = .046 with 90% CI [.039, .052], and SRMR = .041. It is also statistically significantly better than the other models based on chi square difference tests. The only other model that could reasonably contend for acceptance in this analysis is the correlated traits model. However, the correlated traits model did not meet the goodness of fit criteria set forth by Hu and Bentler (1999) and demonstrated poorer fit than the bifactor model. Furthermore, the overarching general factor of gameplay enjoyment, which is absent in the correlated traits model, but present in the bifactor model, is of theoretical importance and supports the acceptance of the bifactor model. Thus, for its goodness of fit, chi square, and theoretical superiority, the bifactor model was determined to be the optimal representation. Table 3 presents loadings, standard errors, and descriptions for the bifactor model variables. A graphical representation of the bifactor gameplay enjoyment model is presented in Figure 1.

Table 1. Nested model comparison of CFI, RMSEA, and SRMR

Model	χ^2	df	CFI	RMSEA	SRMR
Single Trait	2138.246	375	.653	.120	.110
Correlated Traits	758.474	360	.922	.058	.058
Second Order	952.052	378	.885	.070	.085
Bifactor	557.823	332	.956	.046	.041

Note. χ^2 = chi square; df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 2. Nested model comparison of Chi-Square Differences

Model	Single Trait	Correlated Traits	Second Order
Single Trait	--		
Correlated Traits	1379.772	--	
Second Order	1186.194	193.578	--
Bifactor	1580.423	200.651	394.229

Note. Absolute differences in chi-square values between models are displayed. All differences are statistically significant at $p < .001$.

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Table 3. Gameplay enjoyment model variable descriptions, loadings, and standard errors

Variable	Description	Unstd. Load[a]	Std. Error[a]	Std. Load[a]	p^a	Subfactor	p^b	Unstd. Load[b]	Std. Error[b]	Std. Load[b]
1	Difficult to master	1.000		.510	--	Challenge	--	1.000		.610
2	Difficult to beat	1.208	.092	.636	***	Challenge	***	1.131	.105	.711
3	Challenging difficulty level	1.180	.116	.649	***	Challenge	***	.663	.074	.435
4	Challenging obstacles	1.387	.151	.759	***	Challenge	***	.333	.071	.218
5	Socialize with others	.593	.157	.282	***	Companionship	--	1.000		.687
6	Played by many at parties	.374	.145	.179	**	Companionship	***	.888	.089	.614
7	More than one player	.211	.153	.093		Companionship	***	1.150	.105	.734
8	Cooperate with others	.694	.162	.332	***	Companionship	***	1.019	.086	.707
9	Display skills in public	.713	.149	.330	***	Competition	--	1.000		.568
10	Best players recognized	.754	.150	.360	***	Competition	***	1.077	.114	.631
11	Compete with others	.895	.163	.395	***	Competition	***	1.160	.127	.628
12	Compare skills with others	1.063	.170	.488	***	Competition	***	1.239	.120	.699
13	Play with others online	.817	.168	.338	***	Competition	***	1.288	.137	.656
14	Explore unfamiliar places	1.438	.190	.699	***	Exploration	--	1.000		.048
15	Discover unexpected things	1.553	.185	.816	***	Exploration		- .001	.241	.000
16	Experiment with strategies	1.264	.161	.700	***	Exploration		.039	.267	.002
17	Search for hidden things	1.409	.189	.670	***	Exploration	**	.812	.276	.038
18	Explore inner workings	1.332	.183	.656	***	Exploration	**	1.265	.367	.062
19	Fictional characters	.687	.155	.343	***	Fantasy	--	1.000		.551
20	Abilities not in real world	1.164	.196	.528	***	Fantasy	***	1.036	.122	.518
21	Character is other identity	1.323	.210	.576	***	Fantasy	***	1.052	.126	.505
22	Imaginary creatures	.802	.173	.394	***	Fantasy	***	1.398	.131	.758
23	Character is other species	.753	.171	.364	***	Fantasy	***	1.331	.135	.709
24	Fantasy world setting	.747	.180	.349	***	Fantasy	***	1.549	.146	.797
25	Reaistic sound effects	1.053	.158	.486	***	Fidelity	--	1.00		.477
26	3D graphics	.757	.153	.327	***	Fidelity	***	.800	.134	.357
27	Liflike animations	1.119	.167	.524	***	Fidelity	***	1.274	.157	.616
28	Reaistic graphics	.981	.152	.475	***	Fidelity	***	1.388	.184	.694

Note. Variable numbers correspond to those displayed in Figure 1.

[a]Value associated with variable's relationship to the general factor of Enjoyment.

[b]Value associated with variable's specific subfactor.

*$p < .05$ **$p < .01$ ***$p < .001$

Note that three statistically non-significant paths appear in the accepted model. Recall that the bifactor model depicts competition between variable loadings between an overarching general factor and several subfactors. Therefore, it can be expected that a variable which loads very strongly on either the general factor or a specific subfactor may cease to load strongly on the other. This is demonstrated within the accepted model. Item 7 loads strongly on the Companionship subfactor, but does not achieve statistical significance on the general Enjoyment

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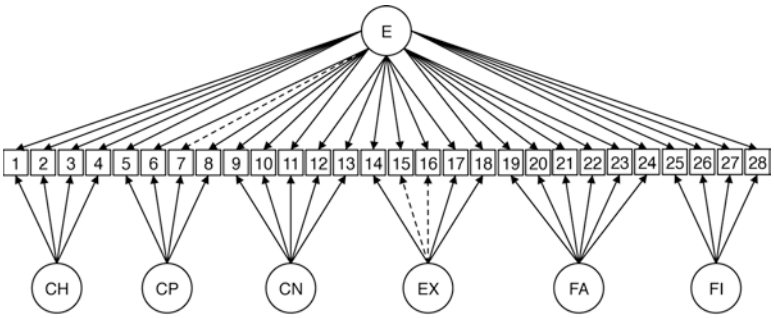
Figure 1. Graphical representation of the bifactor Gameplay Enjoyment Model. CH = Challenge; CP = Companionship; CN = Competition; E = Enjoyment; EX = Exploration; FA = Fantasy; FI = Fidelity. Dashed lines indicate statistically non-significant paths. Paths correlating the six subfactors and item pairs 4-28, 5-22, and 25-26 are suppressed to improve readability. Measured variable numbers correspond to those listed in Table 3.



factor. Meanwhile, items 15 and 16 load strongly on the general Enjoyment factor and cease to maintain statistical significance on the Exploration subfactor. Nevertheless, these statistically non-significant paths were retained in the model for two reasons. First, they are of theoretical importance to the model and retaining them provides a clearer description of the features that compose the general factor and the six subfactors of gameplay enjoyment. Second, removing these paths would not substantially alter the model's fit (no change to CFI, -.001 to RMSEA, and +.004 to SRMR).

Another point of clarification is offered regarding three correlated residual pairs found in the accepted model. These occur between variables 4 and 28, 5 and 22, and 25 and 26. The decision to free these paths was made based upon an examination of the model's modification indices. The correlated residuals suggest that some additional variance exists between these item pairs beyond what is explained by the model.

DISCUSSION

From these results, GEM is composed of a general factor of Enjoyment, measured by 28 game features, and six specific subfactors, Challenge, Companionship, Competition, Exploration, Fantasy, and Fidelity, each measured by 4 to 6 features. Each model component is described along with its potential implications for the design of educational games. Limitations and directions for future research are discussed.

Enjoyment

The general factor of Enjoyment can be thought of as representing one's overall sentiment towards video games. It is based on all 28 measured variables and therefore gives a global indication of a person's enjoyment of the included game features. While evidence exists linking enjoyment to several positive outcomes in education (Blunsdon et al., 2003; Gomez et al., 2010; Mitchell et al., 2005; Muilenburg & Berge, 2005; Pekrun et al., 2002), little is currently known about the relationship between learning and enjoyable gameplay. Since enjoyment is the primary experience associated with gameplay (Garris, et al., 2002; Ritterfeld & Weber, 2006; Vorderer, et al., 2006; Vorderer, et al., 2004) and considered a prerequisite for the effectiveness of serious games (Fu, Su, & Yu, 2009; Heeter, Lee, Magerko, & Medler, 2011), it is reasonable to expect that similar positive learning outcomes can result from well-designed gameplay. Nevertheless, such determinations can only be made through future research. For instance, one might explore whether enjoyment in an educational game

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predicts academic achievement associated with that game, building from Pekrun et al.'s (2002) finding that enjoyment of the academic environment predicted high academic achievement.

GEM offers a way to measure player enjoyment, including individual differences in preferences. It also delivers operationalized features that can be implemented to create enjoyable games. Thus, GEM can be used to design games that advance the understanding of how gameplay enjoyment relates to learning, as well as examine how specific features influence learning outcomes for a variety of players.

Challenge

All six of the GEM subfactors can be defined by their underlying game features. Thus, Challenge is the enjoyment of games that involve challenging obstacles to overcome, a challenging difficulty level, and being difficult to beat and master. The role that challenge plays in gaming has been discussed at length in preceding works (Garris et al., 2002; Heeter, Winn, Winn, & Bozoki, 2008; Hoffman & Nadelson, 2010; Malone, 1981; Malone & Lepper, 1987; McNamara et al., 2010; Wilson et al., 2009). However, GEM provides a concrete definition for Challenge, as well as implementable features that can be used to test the impact of challenge in educational games, both of which have been absent to date.

In addition, Flow (Csikszentmihalyi, 1990) is a related concept that appears frequently in the games literature (Fu et al., 2009; Hsu & Lu, 2004; Nacke & Lindley, 2008; Sweetser & Wyeth, 2005; Wang & Chen, 2010). Flow and enjoyment share similar qualities, such as increased concentration, a reduced sense of time, and enhanced intrinsic motivation (J L Sherry, 2004). A key aspect of the flow experience is that it occurs when the level of challenge that a player experiences is optimal. Too little challenge induces boredom, while too much challenge leads to frustration (Csikszentmihalyi, 1990; Winn, 2008). Challenge is also a key aspect of GEM, which provides a method for designing games with an optimal level of Challenge to match players' individual preferences. To the extent that a game's implementation of Challenge features is consistent with its audience's preferences for those features, the more capable the game should be of provoking experiences of enjoyment and flow.

Companionship

Companionship is the enjoyment of games that involve more than one player, cooperating with other players, socializing with other players, and playing with many people at parties. Educators with an interest in collective learning practices, such as those based on social learning (Bandura, 1977) and computer-supported collaborative learning (Stahl, Koschmann, & Suthers, 2006) theories, can look to Companionship for a set of features specifically geared towards increasing enjoyment in social, cooperative, multiplayer gaming contexts. While these theories have been studied extensively in the field of education, there is substantial room for them to be applied to educational games. For instance, one might examine whether a collaborative learning game designed with Companionship features increases student enjoyment and performance in the context of a computer-supported collaborative learning environment.

Competition

Competition is the enjoyment of games that involve competing against other players, comparing skills with other players, playing online with others, displaying one's skills in public, and public recognition of the very best players. While competition has shown negative impacts on motivation in certain contexts (Deci, Betley, Kahle, Abrams, & Porac, 1981; Deci, Koestner, & Ryan, 1999), it has also increased motivation and performance in other contexts (Burguillo, 2010; Tauer & Harackiewicz, 2004). Furthermore, GEM supplies empirical support for the importance of Competition to the enjoyment of certain players. Therefore, it is not prudent for educators to fear the use of or hold an unmitigated philosophy against including competitive features in educational games. Rather, it is critical to understand the

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desirability of Competition to one's players and the context in which competitive play will occur. Providing a game high in Competition to players who enjoy it is likely to be effective. Meanwhile, the same game would be less pleasant for those players who do not enjoy Competition.

Exploration

Exploration is the enjoyment of games that involve searching for hidden things, discovering unexpected things, exploring unfamiliar places, experimenting with different play strategies, and exploring the inner workings of a game. Interest in the enjoyment of exploration in games has already lead to preliminary research on the topic and its relation to the educational tradition of goal orientation (Heeter, Lee, Medler, & Magerko, 2011). Strong correlations were found between undergraduate students' classroom and in-game goal orientations. Further, student's enjoyment of exploration was found to differ significantly according to their goal orientations. Lastly, the authors called for research on the components that underlie the enjoyment of exploration. GEM's delivers on this request with specific features that influence player enjoyment of Exploration in games. Additionally, the stage is set for further examination of learners' goal orientations in relation to gaming, not only for Exploration, but also for the other facets of GEM. Such pursuits would expand upon the promising work that has begun in games and learner goal orientations (Heeter et al., 2011; Hoffman & Nadelson, 2010; Magerko, Heeter, & Medler, 2010).

Fantasy

Fantasy is the enjoyment of games that involve a fantasy world setting, imaginary creatures, and characters that are fictional, take on identities and species that are different from the player's own, and have abilities that are not found in the real world. Elements of fantasy have been noted many times in the literature for their potential to motivate and engage learners (Malone & Lepper, 1987). Some experimental work has already taken place around the concept of fantasy and educational games. Children in two studies by Parker and Lepper (1992) preferred an educational computer program that incorporated fantasy elements and showed enhanced learning and transfer over conditions that did not involve fantasy. In addition, Cordova and Lepper (1996) found that students who played an educational game with a space exploration or pirate theme showed improved posttest learning scores, a higher propensity to choose more challenging in-game activities, and more sophisticated strategic play, compared to students who played the same game devoid of fantasy elements. These early works suggest that Fantasy can be a valuable motivator and lead to positive learning outcomes when incorporated into educational games. GEM provides a robust set of features that can be used to implement Fantasy into educational games to seek a better understanding of the potential learning benefits. For instance, one might explore the extent to which including Fantasy in an educational game, as operationalized by GEM features, leads to improved learning outcomes, as it did in the mentioned prior works (Cordova & Lepper, 1996; Parker & Lepper, 1992).

Fidelity

Fidelity is the enjoyment of games that have realistic graphics and sound effects, 3D graphics, and lifelike animations. Research on the impacts of Fidelity in learning games is lacking. A related concern is that educational games tend to neglect aesthetic design considerations, perhaps out of a belief that features like realistic 3D graphics are not consequential to achieving learning objectives. On the contrary, GEM empirically demonstrates that Fidelity is an important aspect of enjoyment for some players. Therefore, educational game designers would be wise not to make presumptions about the value of aesthetic game features. Instead, players' preferences for Fidelity should be gauged and educational games should be designed to match the importance that players place on aesthetic features. In this manner, games can be created with the suitable amount of Fidelity that players will enjoy.

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Limitations and Future Research

It is important to note the limitations of and essential directions for future research derived from this research. To begin, this study is limited in generalizability by its sample, which was drawn from a large public university in the United States. Examining GEM in diverse demographic contexts would expand the understanding of the model's generalizability, as well as gameplay preference as a cultural phenomenon. Furthermore, although early evidence for the validity and stability of GEM has been provided through this confirmatory study, the model may still have room to be expanded. Accordingly, future work will be conducted to further refine and validate GEM.

In addition, a limitation from the preceding discussion of GEM components and prior research is that perfect comparisons are not possible. Prior studies may use similar terminologies, but tend to lack the specificity and robustness of GEM. Therefore, while conditions in earlier studies resemble GEM components, they are not identical. Hence, the preceding discussion has not made any strict determinations about what GEM components will lead to learning outcomes. Instead, prior research has been leveraged to provide an indication of where GEM can be most beneficially employed to examine the potential learning outcomes associated with enjoyable gameplay. Much valuable future research should be conducted in this area.

Following, it is critical to clarify that GEM is a model of individual, personalized player enjoyment. As such, potential users of this model should recognize that players have diverse gameplay preferences. For example, providing a game that is high in Fantasy to a random group of students can only be expected to be effective for those students who have a high preference for Fantasy. The importance of understanding diverse player preferences has been recognized from the earliest research on digital games (Malone, 1981) through today (Young, et al., 2012). Therefore, it is necessary to consider the needs of one's audience and assess players' preferences prior to providing them with an educational game. Researchers would be wise to select participants whose preferences align with the GEM components being examined and to test multiple versions of games, thereby distinguishing the impacts and interactions between personal preferences and game design features.

CONCLUSION

The Gameplay Enjoyment Model (GEM) provides an empirical framework within which vital progress can be made to improve the understanding of enjoyment in games and the role that games play in education. GEM is composed of operationalized game features that can be incorporated directly into design-based, quantitative, and qualitative research approaches to explore the benefits of serious games. In such pursuits, it is critical to appreciate that players have diverse preferences for games. Therefore, when considering the research, design, and implementation of any serious game, it is essential to understand the preferences of the audience who will ultimately experience and learn from that game. Much work still needs to be done to explore the relationships between games, enjoyment, individual differences, and learning. GEM provides an empirical foundation for furthering the understanding of games and their impacts on players with diverse gameplay preferences.

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APPENDIX

Gameplay Enjoyment Instrument Items by Factor

Challenge

The game is difficult to beat.
The game is difficult to master.
The game is set at a challenging difficulty level.
The game includes challenging obstacles that must be overcome.

Companionship

The game requires more than one player.
The game requires me to cooperate with other players.
The game allows me to socialize with others.
The game can be played by many people at parties.

Competition

The game allows me to compare my skills with other players.
The game allows me to play with other people online.
The game publicly recognizes the very best players.
The game requires me to compete against other players.
The game allows me to display my skills in public.

Exploration

The game allows me to explore its inner workings.
The game allows me to explore unfamiliar places.
The game allows me to search for hidden things.
The game allows me to experiment with different play strategies.
The game allows me to discover unexpected things.

Fantasy

The game is set in a fantasy world.
The game world contains imaginary creatures.
The game allows my character to take on a species other than my own.
The game characters are fictional people.
The game characters have abilities that do not exist in the real world.
The game allows my character to take on an identity other than my own.

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Fidelity

The game features realistic graphics.
The game features lifelike animations.
The game features realistic sound effects.
The game features 3D graphics.

Note: Items were rated on a 5-point scale that included Not at all important (1), slightly important (2), somewhat important (3), very important (4), and a must-have feature (5).

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